

REMARKS

In response to the Office Action mailed August 31, 2007, claim 12 is amended, and claim 13 is cancelled. Claims 2, and 5-11 were previously cancelled without prejudice. Claims 1, 3, 4, 12, and 14-18 are now active in this application. No new matter has been added.

FIG. 10 is objected to because the fourth and fifth columns should reflect the 1:4 carbon to fluorine atomic ratio of CF_4 . This rejection is traversed.

The Office Action, at page 2, asserts that three rows do not reflect this ratio: comparative example 1, example 1, and comparative example 2. First, please note that comparative example 2 does reflect a ratio of 1:4, because the stated ratio of 0.005:0.02 is equivalent to a ratio of 1:4. Second, the other two rows reflect ratios of approximately 1:4. Specifically, comparative example 1 stated ratio of 2:9 is approximately 1:4. Further, the example 1 stated ratio of 1:6 is also approximately 1:4. It appears that comparative example 1 and example 1 were performed at approximately 1:4, but with a slight excess of fluorine atoms.

The previous amendments to FIG. 10, filed May 2, 2007, were predicated upon clear typographical errors (a decimal point in the wrong position). However, there do not appear to be any clear typographical errors in the data presently objected to. Thus, Applicants submit that FIG. 10 appears to accurately reflect the experimental data, and that the objection should be withdrawn.

Claims 1, 3, 4, 12, and 14-18 are rejected under 35 U.S.C. §112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. This rejection is traversed.

Regarding independent claims 1 and 12, the Office Action, at pages 3, asserts that there is no general disclosure pertaining to the entire range of less than 1.0 W/cm^2 . However, please note that example 7 of FIG. 10 illustrates 0.28 W/cm^2 , and example 8 illustrates 0.45 W/cm^2 . Thus, at least two experimental examples of very low watt density (less than 1.0 W/cm^2) are provided.

Further, the Office Action asserts that the Applicant does not disclose etching diamond at a power of less than 1.0 W/cm^2 using a mixed gas comprising the elements oxygen, fluorine, and nitrogen. Although FIG. 10 does not expressly list nitrogen, please note that the specification, at page 23 line 7, states, “[w]hen the mixed gas containing CF_4 gas and O_2 gas further contains nitrogen gas, the intensity ratio A/B is improved so that the diamond etching speed is enhanced.” This comment from the specification is generally applicable to all of the experimental results.

Regarding claims 1, 17, and 18, the Office Action, at page 3, asserts that Example 6 and Example 1 of FIG. 10 do not include nitrogen in the mixed gas. However, as discussed above, the specification, at page 23 line 7, states, “[w]hen the mixed gas containing CF_4 gas and O_2 gas further contains nitrogen gas, the intensity ratio A/B is improved so that the diamond etching speed is enhanced.” This comment from the specification is generally applicable to all of the experimental results.

Regarding the A/B intensity ratio, the Office Action, at page 4, asserts “puzzling” aspects of FIG. 5, and FIG. 6. Specifically, the Office Action states, “[t]he upper line of Figure 5 indicates the emission spectrum from a 100% O_2 plasma yields an A/B ratio of 2.5.” This interpretation is not correct. The upper line (with circle icons) indicates the A/B ratio using emissions at 777nm for A (as an emission band of O or monoatomic oxygen or disassociated) and using emissions at 558nm for B (as an emission band for O_2 or diatomic oxygen or molecular oxygen). In other words, a high A/B ratio indicates that there is a high amount of O (or monoatomic or disassociated oxygen) in

comparison to the amount of O₂ (or diatomic oxygen or associated oxygen or molecular oxygen). Please see page 21 and page 23 of the specification for additional discussion of the emission wavelengths. Thus, the interpretation of the Office Action regarding FIG. 5 is not correct.

Thus, for the above reasons, Applicants submit that claims 1, 3, 4, 12, and 14-18 are described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. The specification provides ample experimental results over wide ranges, and no undue experimentation is required to practice the claimed invention.

Claims 1, 3, 4, 12, and 14-18 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Shiomi, “High-Rate Reactive Ion Etching of Diamond and Fabrication of Porous Diamond for Field-Emission Cathode” (hereinafter Shiomi), in view of U.S. Patent 6,261,726 to Brooks et al. (hereinafter Brooks), and further in view of U.S. Patent 6,013,191 to Nasser-Faili et al. (hereinafter Nasser-Faili). Applicants traverse this rejections.

Independent claim 1 recites, in part, “forming a diamond substrate with a mask layer including a metal layer in at least one part thereof; and etching said diamond substrate formed with said mask layer with a plasma of a mixed gas composed of a gas containing an **oxygen atom** and a gas containing a **fluorine atom**; wherein said **fluorine atom has a concentration within the range of 0.04% to 6%** with respect to the total number of atoms in said mixed gas, said plasma is produced by generating a high-frequency discharge between two plate electrodes, said high-frequency discharge is generated by supplying an electric power of **less than 1.0 W/cm²** between said plate electrodes, and said mixed gas further contains **nitrogen gas**, thereby to form the diamond product having the projection or depression with a side face with an angle of inclination of at least 78 degrees, wherein said mixed gas contains nitrogen gas in an amount

such that the intensity ratio A/B of said mixture is greater than the intensity ratio A/B of pure oxygen, where A is the intensity of an emission peak caused by atomic oxygen and B is the intensity of an emission peak caused by molecular oxygen.”

Independent claims 12, 17, and 18 each recite a fluorine atom concentration **“within the range of 0.04% to 6%”**.

Independent claim 15 recites, in pertinent part, “diamond product having a projection or a depression on a surface thereof, the projection or depression having at least one side face with an **angle of inclination of at least 78 degrees**.”

In order to establish a *prima facie* obviousness under 35 U.S.C. § 103(a), all the claim limitations must be taught or suggested by the prior art. *In re Rokay*, 490 F. 2d 981, 180 USPQ 580 (CCPA 1974). Further, “rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *In re Kahn*, 441 F. 3d 977, 988 (Fed. Cir. 2006). At a minimum, the cited prior art does not disclose (expressly or inherently) the above recited limitations.

The Office Action, at pages 6, asserts that “Shiomi teaches that vertical sidewalls can be obtained by adding very small amount of CF₄. Shiomi teaches using a CF₄ concentration as low as 0.125% (page 5, line 2).” However, please note that the Shiomi pages are numbered as: 7745, 7746, 7747, and 7748 (there are only 4 pages). Thus, it is not clear what page the Office Action refers to. Additionally, Shiomi, at the Conclusions section on page 7748, states “optimum ratios of CF₄/O₂ (=10-20%).” Further, Shiomi, at FIG. 2, illustrates 12.5%. Thus, Applicants request clarification regarding what portions of Shiomi are relied upon for the rejection.

The Office Action, at page 6, admits that Shiomi does not teach supplying less than 1.0 W/cm², and does not teach using both O₂ and N₂ in the plasma gas. Further, please note that Shiomi does not teach or suggest that the **“fluorine atom has a concentration within the range of 0.04% to 6%”** as recited by claim 1.

The Office Action, at page 6, asserts that Brooks teaches etching with a mixture of O₂ and N₂ at column 6, line 63. However, Brooks, at column 6, lines 59 to 64, merely discloses “[e]tching high aspect ratio features with good pattern fidelity is possible using organic agents. Good results have been achieved using low pressure reactive ion etching containing oxygen, e.g., an O₂ / N₂ plasma etch. . . Optionally, additives such as CO, CO₂ or hydrocarbons may be employed.” Thus, Brooks makes no mention of fluorocarbons such as CF₄. Brooks is limited to carbon oxides and hydrocarbons as additives.

The Office Action, at page 7, asserts that it would have been “obvious” to etch diamond with plasma comprising O₂ and N₂ and a fluorine-containing compound because Shiomi teaches using either O₂ or N₂ and because “[i]t is prima facie obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition which is to be used for the same purpose,” citing *In re Kerkhovan* 205 USPQ 1069 (CCPA 1980). However, none of the cited art discloses that the **“fluorine atom has a concentration within the range of 0.04% to 6%”** as recited by claim 1.

Thus, at a minimum, the combination of Shiomi and Brooks Nasser-Faili fails to teach or suggest the forgoing limitation, and therefore does not render independent claim 1 obvious.

Further, Applicant submits that independent claims 12, 17, and 18 are allowable for at least the same reasons as independent claim 1.

Under Federal Circuit guidelines, a dependent claim is allowable if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987).

Thus, as independent claims 1 and 12 are allowable for the reasons set forth above, it is respectfully submitted that dependent claims 3, 4, 14, and 16 are also allowable for at least the same reasons.

As stated above, independent claim 15 recites, in pertinent part, “diamond product having a projection or a depression on a surface thereof, the projection or depression having at least one side face with an **angle of inclination of at least 78 degrees.**”

The Office Action does expressly discuss this angle of inclination feature of claim 15. Thus, Applicant submits that this feature is not disclosed by the cited art.

Thus, at a minimum, the combination of Shiomi and Brooks Nasser-Faili fails to teach or suggest the forgoing limitation, and therefore does not render independent claim 15 obvious.

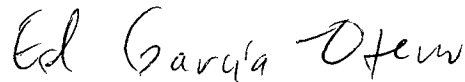
Accordingly, it is urged that the application, as now amended, is in condition for allowance, an indication of which is respectfully solicited. If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, Examiner is requested to call the undersigned attorney at the telephone number shown below.

Application No.: 10/774,417

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 500417 and please credit any excess fees to such deposit account.

Respectfully submitted,

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